



Integration of components into RMs. Test plan for RMs/RBXs at FNAL, CERN

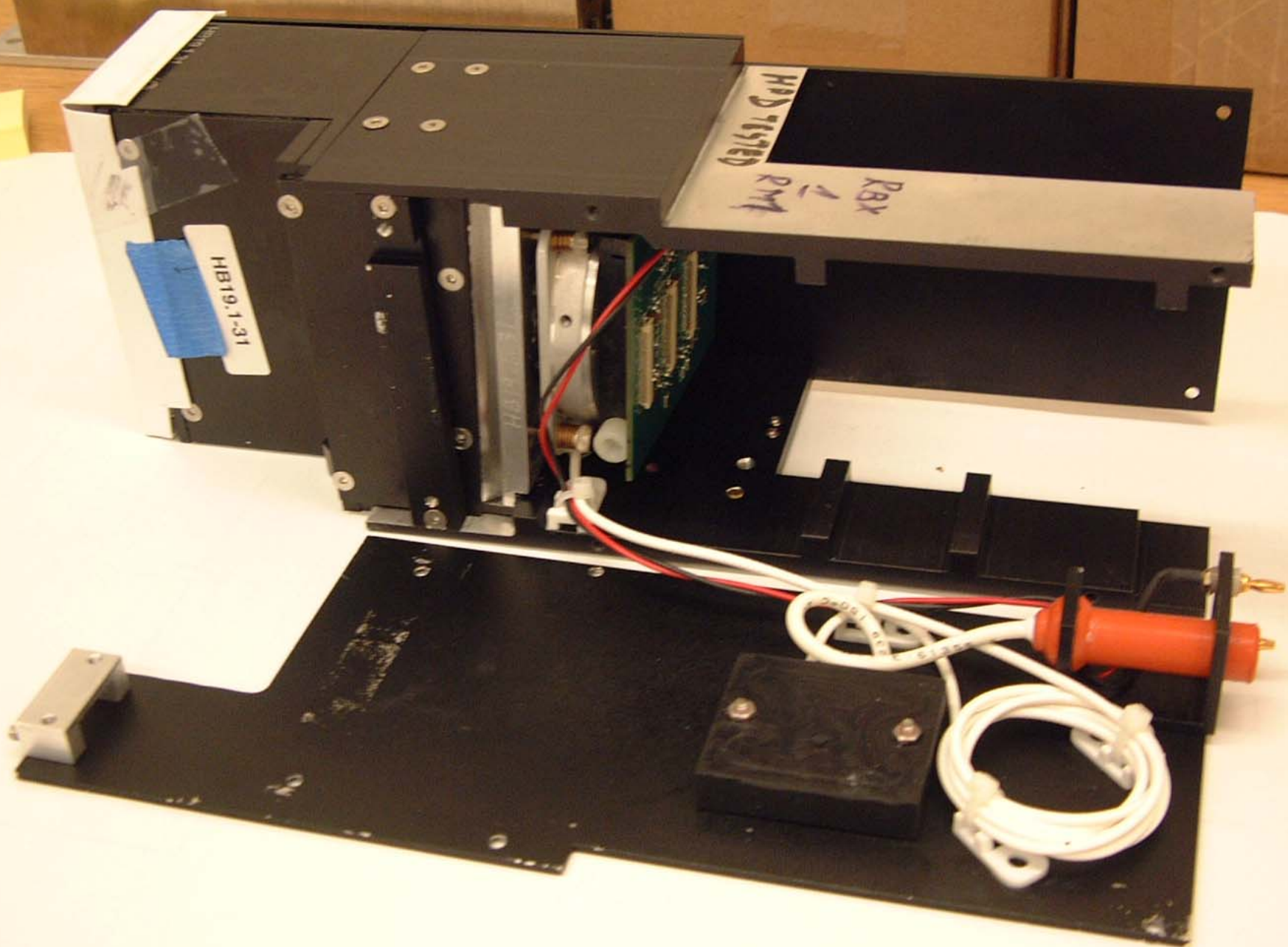
**Anatoly Ronzhin,
Fermilab**

December, 2002
for ESR meeting

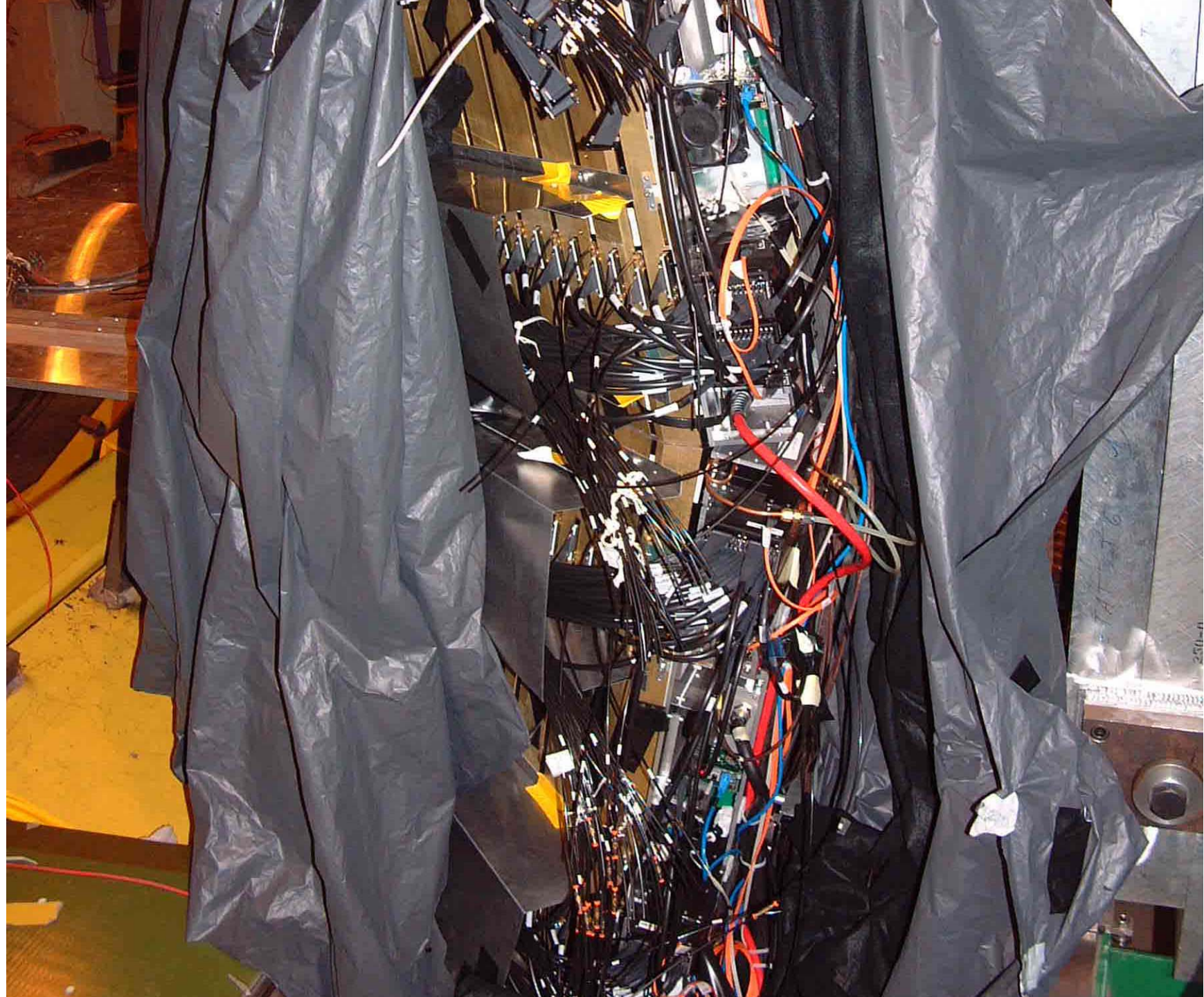


Outline

- **8 RMs/2 RBXs performance, CERN test beam 02.**
- **RMs assembly.**
- **Equipment for RBXs integration at Fermilab.**
- **RBXs test.**
- **RBXs QC.**
- **DAQ, software for the QC.**
- **RMs/RBXs for 2003 test beam, CERN.**
- **Installation and test of the RBXs at CERN.**
- **Schedule.**
- **Summary and Conclusion.**



Parts of RM1





8 RMs/2 RBXs performance

- **8 RMs/2 RBXs were assembled and tested by Terry, Julia, Sergey, Anatoly and supporting personal before summer 02 test beam at CERN.**
- **No failure in the system (144 channels) was observed during the test beam time (about 2 months).**
- **Items in part to improve the current RM design were defined, will be implemented into production plan. The observed difference of the RMs response partially understood. Postmortem needed for more details.**



RMs assembly

- **The main parts of RM are:**
 - **1. RM shell.**
 - **2. Optical Decoder Unit (ODU).**
 - **3. HPD with interface card and mounting ring.**
 - **4. HV/BV cable/wires, connectors, mounting.**
 - **5. 3 QIE circuit boards with cooling extrusion.**
 - **6. Part of the RM OUT optical link.**
 - **7. Locker.**

Procedure of RMs assembly with all components is already well defined. We have experience with HB RMs gathering. RMs will be assembled at lab. 5. It should not be noticeable problems with RMs for HE, because the main parts are the same as for HB.



RBX components

RBX contains the next main components

- 1. RBX shell.**
- 2. HV/BV distributor and backplane.**
- 3. Electrical back plane.**
- 4. HV/BV unit.**
- 5. LV unit.**
- 6. 4 RMs.**
- 7. Calibration unit.**
- 8. CCM.**
- 9. Water cooling pipe.**
- 10. Nitrogen manifold.**
- 11. Thermo control system.**



Equipment for RBXs Integration at Fermilab

Equipment needed for RBX integration and test at Fermilab:

- **RBX with all described components.**
- **DAQ, software.**
- **HV/BV power supply.**
- **LV power supply.**
- **Laser with light attenuation wheel.**
- **Service components (water cooling system, nitrogen flow system, temperature control).**

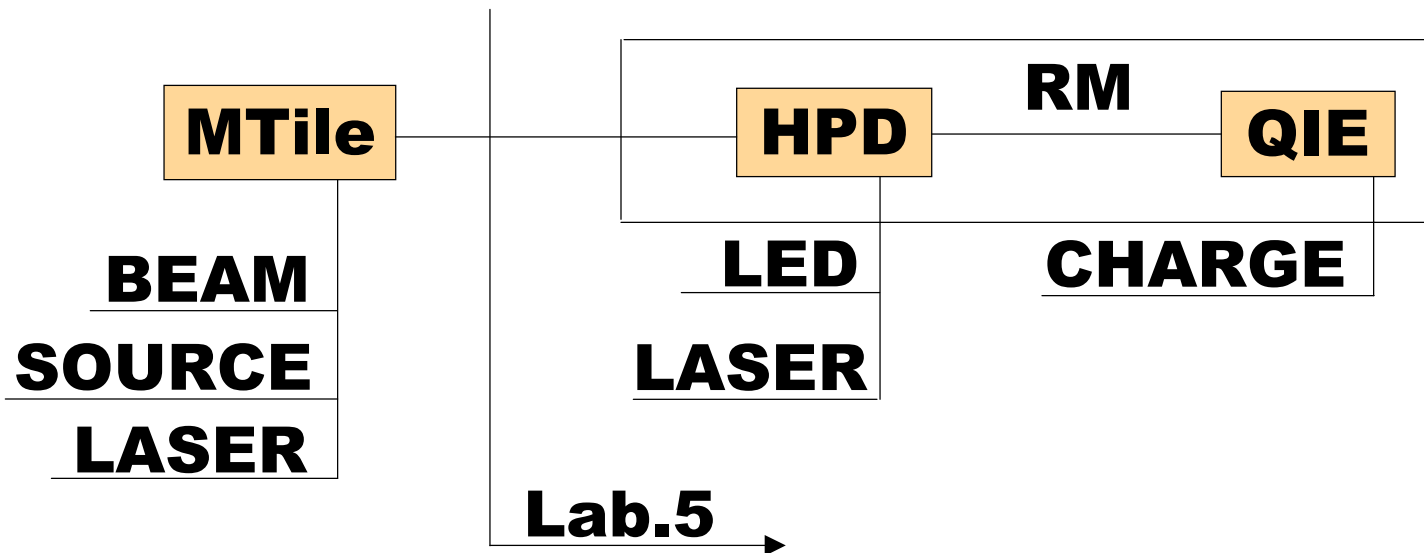


RBXs test

1. HV/BV crate, cable, filter, unit, keep 10kV/80V without sparking, discharge. HV, BV currents are under specs. The LV current meets specs.
2. Water cooling system operational, thermal sensors show 26 +/- 1 C.
3. Test of RMs functionality with calibration unit in LED mode. For not properly working RM – identify problem – broken contact, not working channel, burning, etc. Fix it.
4. Get response of the RMS in range +/- 5% under the same HV/BV and fixed light illumination. If not, the RMs could be unified, say, in 3 groups with +/-5 % spread of the responses under the same HV/BV. Possible bigger difference in the response must be clear understood (e.g. HPD QE, gain, etc.). Also define HV/BV individually for each channel to get response in the range. Put in database.
5. Take data (calibration unit in LED mode) with light amount corresponding to low, middle and high parts of the dynamic range. File its in database.



RMs “calibration” at lab.5



1. “Calibration” of QIE, 5% accuracy expected.
2. “Calibration” of HPD (QE, gain, Minn. $<3\%$).
3. “Calibration” of RM (calibration unit, LED mode). Test of the RM dynamic range with light amount, matching CMS HCAL. The RMs responses should be equalized with about 5%.



RBXs QC

1. **Measure HPDs leakage current in the RMs package.**
2. **Measure noise (pedestal width) for each channel.**
3. **Test dynamic range of each HPD/QIE channel with calibration unit (LED mode). The chosen HV should be consistent with the dynamic range.**
4. **Test HPD/QIE linearity with calibration unit (LASER mode, probably). The laser light must be normalized on PIN diode response.**
5. **Test of 40 MHz HPD/QIE performance. The measurement conditions should be specified.**
6. **RBXs stability test with calibration unit (LASER mode, partially LED mode). HV/BV voltage, current; HPD/QIE response for each channel, power consumption, temperature record during about 1 week.**
7. **File data taken.**



DAQ, software for the QC

DAQ, software should be the same as will be used for the test beam 2003.



RMs/RBXs for 2003 test beam

Should be assembled, tested and ready for shipment to CERN on March 30, 2003:

2 HE RBXs, 2 HB RBXs.

In 2 HB RBX used in 2002 test beam the 8 HB RMs should be disassembled and QIE cards should be replaced (33 to 40 MHz) if to use them on 2003 test beam. The RM itself is also should be slightly modified. More likely to make more brand new HB RBXs with RMs for 03 test beam.

1 HE RBXs with 2 HE RMs was delivered to FNAL on October 29, 02. Integration started.



FE production schedule for integration

ID	Task Name	Duration	Start	Finish	2003				2004				2005						
					Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct				
1	GOL Production	100 days	Mon 8/19/02	Fri 1/3/03															
2	Fabricate	50 days	Mon 8/19/02	Fri 10/25/02															
3	Package	30 days	Mon 10/28/02	Fri 12/6/02															
4	Test	20 days	Mon 12/9/02	Fri 1/3/03															
5	CCA Production	65 days	Mon 8/26/02	Fri 11/22/02															
6	Package parts	30 days	Mon 8/26/02	Fri 10/4/02															
7	Test Parts	35 days	Mon 10/7/02	Fri 11/22/02															
8	QIE Production	140 days	Mon 7/22/02	Fri 1/31/03															
9	Fabricate	55 days	Mon 7/22/02	Fri 10/4/02															
10	Get/package 1st two wafers	20 days	Mon 10/7/02	Fri 11/1/02															
11	Finish Fab of 24 wafers	10 days	Mon 11/18/02	Fri 11/29/02															
12	Package 24 wafers	20 days	Mon 12/2/02	Fri 12/27/02															
13	Test QIEs (2 techs)	25 days	Mon 12/30/02	Fri 1/31/03															
14	RD49 LV Regulators	90 days	Mon 9/30/02	Fri 1/31/03															
15	1000 parts avail. Sept '02	20 days	Mon 9/30/02	Fri 10/25/02															
16	50000 parts avai early '03	20 days	Mon 1/6/03	Fri 1/31/03															
17	Commercial Parts	65 days	Mon 9/16/02	Fri 12/13/02															
18	Order Parts	5 days	Mon 9/16/02	Fri 9/20/02															
19	Receive Parts	60 days	Mon 9/23/02	Fri 12/13/02															
20	Pre-Prod PCBs (new QIE/power/gnd/cable)	25 days	Mon 10/21/02	Fri 11/22/02															
21	Order Boards	10 days	Mon 10/21/02	Fri 11/1/02															
22	Assemble	5 days	Mon 11/4/02	Fri 11/8/02															
23	Test	10 days	Mon 11/11/02	Fri 11/22/02															
24	Produce/Assemble FE modules	195 days	Mon 11/25/02	Fri 8/22/03															
25	Order200+ Boards (TB/Rad/Reliability)	20 days	Mon 11/25/02	Fri 12/20/02															
26	Assemble Boards (TB/Rad/Reliability)	50 days	Mon 12/23/02	Fri 2/28/03															
27	Order Boards - Production	15 days	Mon 5/26/03	Fri 6/13/03															
28	Assemble Boards - Production	50 days	Mon 6/16/03	Fri 8/22/03															



HCAL meeting at Boston University, November 1, 2002



Installation and test of RBXs at CERN

RBXs will be delivered to CERN already tested at FNAL.

The RBXs will be partially tested after installation on wedges. The goal of the test is to check again functionality, i.e. to pass the test performed at FNAL. Part of equipment needed for that e.g. HV/BV crates, several short HV/BV cables, part of LV, etc.

“Calibration” of each RM (LED mode) will be repeated.

Must reproduce FNAL data. Laser “calibration” of the RMS (calibration unit, LASER mode) will be done, also as sourcing. It’s a start point to monitor LED/LASER/SOURCE ratios.

It will be not tested on the stage the “final” HV/BV crates with modules, HV/BV cables; LV power supplies, cables; water cooling system, nitrogen flow system, optical links, interference with other subsystems, etc.

The schedule and personnel to complete installation and the test of RMs/RBXs at CERN defined.



RBXs installation schedule

ID	Task Name	Duration	Start	Finish	2003			2004				2005			
					Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct
65	Install HE- RBXs on Detector (qty 18)	30 days	Tue 7/29/03	Mon 9/8/03											
66	Install HB- RBXs on Detector (qty 18)	30 days	Tue 9/9/03	Mon 10/20/03											
67	HB:End Electronics Installation in RBXs	1 day	Wed 7/16/03	Wed 7/16/03											
68	*** Move HB:End Electronics Installation in RBXs	1 day	Mon 2/2/04	Mon 2/2/04											
69	Install HE+ RBXs on Detector (qty 18)	30 days	Tue 10/7/03	Mon 11/17/03											
70	HE+1:RBXs ready for Installation	1 day	Tue 4/1/03	Tue 4/1/03											
71	*** MoveHE+1:RBXs ready for installation	1 day	Fri 10/10/03	Fri 10/10/03											
72	Install HB+ RBXs on Detector (qty 18)	30 days	Tue 12/2/03	Mon 1/12/04											
73	Install HO 0 RBXs on Detector (qty 12)	20 days	Tue 1/13/04	Mon 2/9/04											
74	Install HO + RBXs on Detector (qty 12)	20 days	Tue 2/10/04	Mon 3/8/04											
75	Install HO - RBXs on Detector (qty 12)	20 days	Tue 3/9/04	Mon 4/5/04											
76	HO:End Electronics Installation in RBXs	1 day	Tue 8/31/04	Tue 8/31/04											
77	Install HF Electronics in 3U EuroCrates	34 days	Wed 1/21/04	Mon 3/8/04											
78	HF Readout Box Installation Complete	1 day	Tue 3/30/04	Tue 3/30/04											
79	Slice 1 in SX5 Complete	1 day	Mon 3/29/04	Mon 3/29/04											
80	Slice II in SX5 Complete	1 day	Tue 11/30/04	Tue 11/30/04											
81	SX5 Magnet Test	1 day	Mon 1/31/05	Mon 1/31/05											



Summary and Conclusion

- **2 HB RBX (8 RMs, 144 channels) passed test beam 2002 (about 2 months) without failure.**
- **As part of production plan the RMs/RBXs integration, test and quality control will be performed at FNAL (lab. 5, also at 14th floor of HR).**
- **The personnel and schedule to complete the task are well defined.**
- **Support of other US CMS groups needed mostly in part of DAQ and software.**